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Impact of in-channel organic debris on fluvial process and channel form Quarterly report to the U.S. Army Corps of Engineers (October 1994)

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Administrative Developments

A 486DX PC has now been purchased in order to carry out survey data transformation, data analysis and document production.

A proposal has been submitted to the U.S. Army Corps of Engineers for funding to continue the work started in this project for the financial year 1995-1996.

Logistics and Travel

Dates have been arranged with C.S.U. for the forthcoming field survey in January 1995. Mr Wallerstein will travel out to Mississippi on 27/28th December and meet up with the field crew in Oxford to commence the three week survey schedule.

Research Progress

A literature review is now in the process of being compiled and written up. The literature review outline is shown on page 5.

In order to obtain a better grasp of debris-channel interactions a"paired catchment" approach will now be employed involving the comparison of degrading channels in catchments with agricultural riparian landuse (i.e. no debris) against degrading channels in catchments with a wooded riparian zone (debris input). comparisons will also be made between stable and unstable channels with, and without, a heavy debris load. The processes in the stable and degrading channels will then be compared.

The scale "effectiveness" of debris jams must also be considered however, in conjunction with the inherent channel dynamics. Headwater, middle and lower reaches must therefore be studied to asses the process-domains of debris-channel interaction. It is hypothesised that these "process-domains" are a function of the scale of the key debris species, that is average tree dimensions compared with average channel width. The key debris species must therefore be identified and some estimation made of their average height (assuming maturity).

Suitable catchments for this more focused analysis will be selected from the current data set and intensive thalweg and cross-section surveys carried out at specific jam sites in the forthcoming field visit.

Data Analysis

All thalweg survey data collected in the May 94 survey has now been processed. Long profiles and Planform plots for each of the 23 sites has been produced and the debris jam locations identified. Figures 1 and 2 show planform and long profile plots for the reach surveyed on Nolehoe creek. Debris jam sites are marked on as triangles with their corresponding site numbers.

Figures 3 and 4 show similar plots for Abiaca Creek (site 4). Because all major debris jams in the DEC creeks have now been surveyed in, their position and stability can now be monitored through future surveys which will provide vital information for developing a management strategy. Subsequent surveys will also show whether there are any significant changes in bed elevation associated with the presence of debris jams, either basal scour due to potential energy dissipation, or sedimentation due to backwater ponding, and will show how debris jam influence changes with drainage basin area (a surrogate of discharge).

Qualitative data associated with the debris jam sites has also been collated. Figure 5 shows the site characteristics for each DEC stream reach surveyed and the number of significant debris jams present in that reach. Figure 6 shows the qualitative variable for each debris jam site. These variables will now be related to drainage basin area and various reach scale factors (for example reach stability, channel sinuosity, riparian vegetation type and channel sediment type) in order to find significant relationships that will help to characterise the spatial pattern of debris jam prevalence and impact upon channel morphology.

Figure 7 shows one relationship that has been explored and would appear, even though the data is as yet limited, to indicate that there is a significant relationship between drain[illegible] area and jam frequency (no. of jams per 1000ft of channel equivalent). This negative relationship is significant at the 95% level using a one-tailed Pearson Product Moment Test.

With a larger data set this relationship may well become better defined and it is likely that the data distribution will be better described by a negative logarithmic regression curve.

Development of the Drainage Basin Debris Management program is now underway. It is intended that this Computerized Management System will be written for the Windows environment, in Visual Basic, providing an easily accessible user interface.

Figures 8 and 9 shows an outline for this program. Input data will take the form of those variables found to be significant in terms of jam-channel interaction. The data will then be processed (see figure 9) and a management output given based upon the relationships developed in this research. The program outline shown in figure 9 is based upon the information and relationships developed thus-far. Other variables to be added to the Debris Management program will include channel stability, channel sinuosity, other in-channel structures and debris input rate and residence time which will provide a vital temporal dimension to the management strategy.

Plans for the Next Quarter

* To continue to develop the relationships now being explored using the May 94 data set.

* Commencement of preliminary coding for a debris management program.

* Compilation of an end of year report to the U.S. Army Corps of Engineers.

Literature Review Outline

1.1 Introduction

1.2 Quantity and Distribution of LWD

- 2.1 Input Processes
- 2.2 Size and Mass of LWD Inputs
- 2.3 LWD Spacing

1.3 In-channel Geomorphic Significance

- 3.2 Effects of Scale
  - 3.2.1 Headwater Streams
    - 3.2.1a Effects on local baselevel and energy dissipation
    - 3.2.1b Pool-riffle spacing
  - 3.2.2 Middle Course and Lowland Rivers
    - 3.2.2a Debris Orientation & Flow Deflection
    - 3.2.2b Depth & Width Adjustment
    - 3.2.2c Sediment Storage & Transport

1.4 Hydraulic Significance of LWD

- 5.1 Effect on channel Roughness
- 5.2 Effect on velocity Distribution
- 5.3 Effect on Flood Frequency

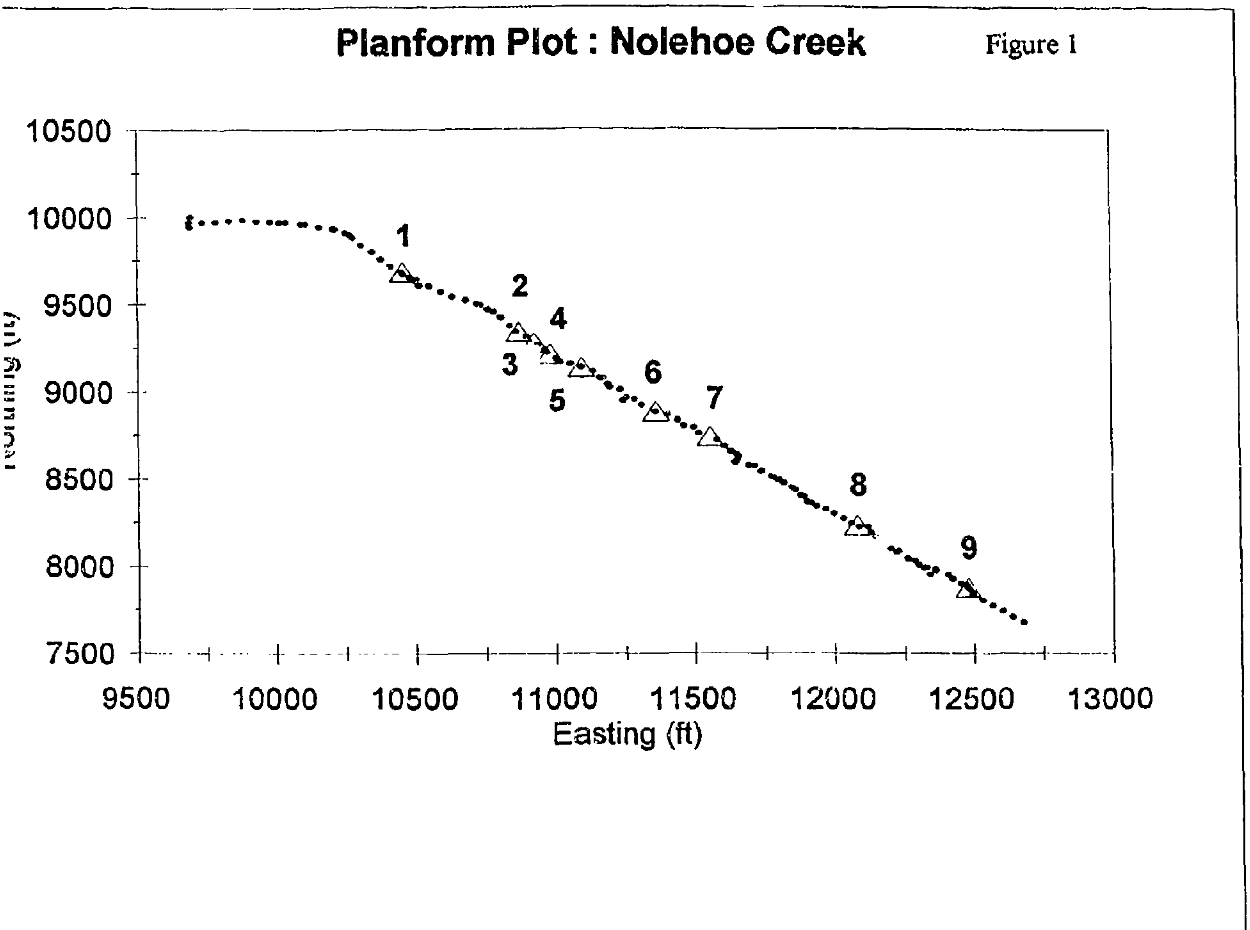
1.5 Impact of LWD on Structures

- 6.1 Bridges
- 6.2 Locks, Dams and Weirs

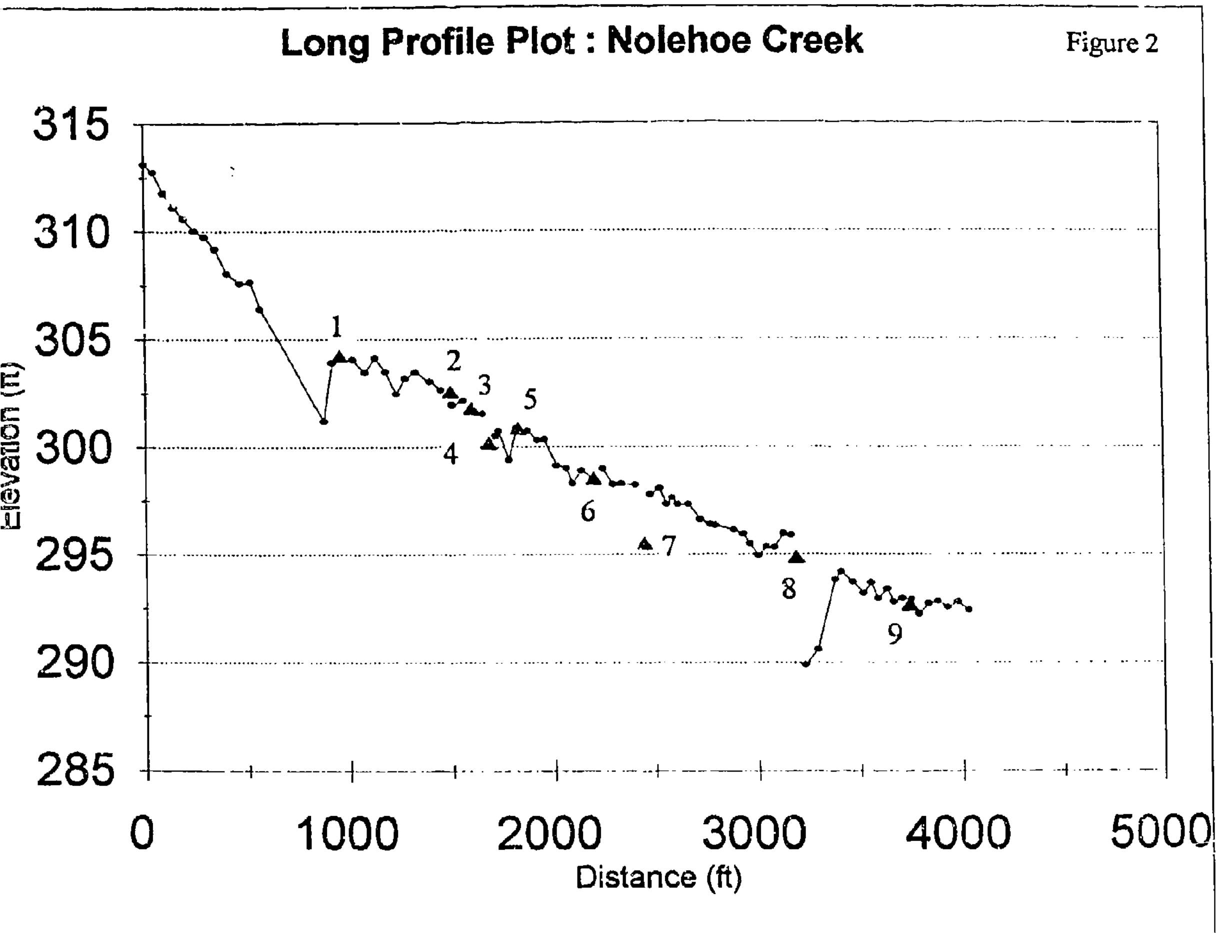
1.6 Management : Policy & Practice

- 7.1 Biological Impacats
- 7.1 Stable woodland streams
- 7.2 Unstable channels

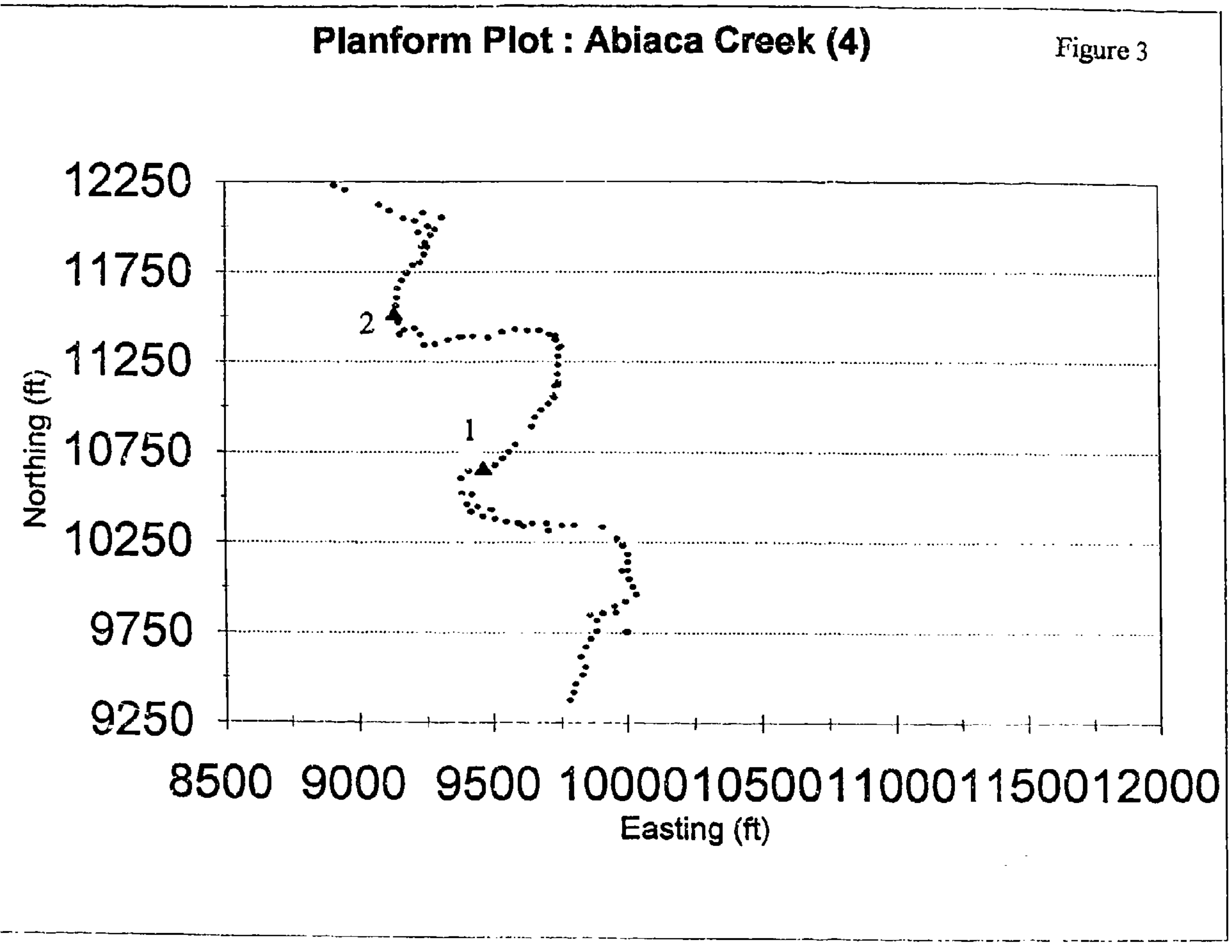
1.8 Conclusions & Research Requirements

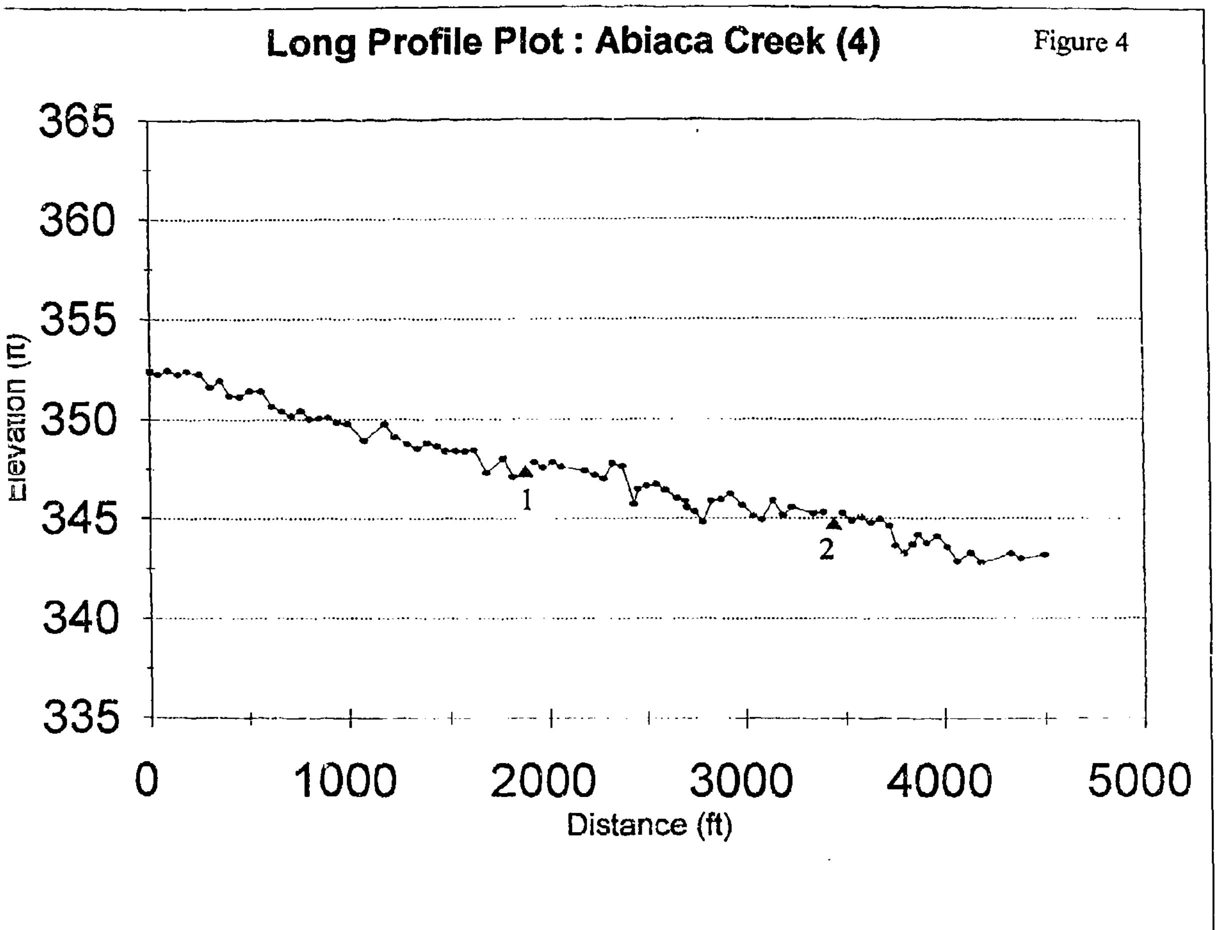


Planform Plot : Nolehoe Creek
Figure 1
10500
10000
9500
9000
8500
8000
7500
Northing (ft)
1
2
3
4
5
6
7
8
9
9500
10000
10500
11000
11500
12000
12500
13000
Easting (ft)



Long Profile Plot : Nolehoe Creek
Figure 2
315
310
305
300
295
290
285
Elevation (ft)
0
1000
2000
3000
4000
5000
Distance (ft)
1
2
3
4
5
6
7
8
9


Planform Plot : Abiaca Creek (4)
Figure 3
12250
11750
11250
10750
10250
9750
9250
Northing (ft)
2
1
8500
9000
9500
10000
10500
11000
11500
12000
Easting (ft)



SITE
Noleh
Sarter
Lick
Burne
James
Long
Sykes
Hotop
Fanne
Worsh
Worsh
Worsh
Abiaca
Harlar
Red B
Otouc
Coila
Abiaca
Abiaca
Abiaca
Lee
Hickal
Hickal
Perry
Harlan

DEC STREAM REACHES SURVEYED MAY 94, THEIR SITE CHARACTERISTICS AND NUMBER OF SIGNIFICANT DEBRIS JAMS PRESENT

Figure 5

	DRAINAGE AREA (sq. mi)	UNSTABLE STABLE TRANS.	STRAIGHT MEANDER	FOREST AG.	SED. TYPE	No. of Jams	No. per 1000 ft of channel
ioe	3.7	unstable	straight	forest	sand/ gravel	9	2.25
·	6.4	trans	straight	?	?	0	
	8.5	unstable	straight	mixed	sand/clay	5	1.25
:y Branch	10	trans	sinuous	?	?	0	
; Wolf	11	unstable	straight	ag	sand	0	
	11	unstable	meandering	?	?	0	
	12.3	?	meandering	?	?	0	
ɔha	17	trans	straight	?	?	0	
gusha	18	unstable	straight	forest	sand	3	0.75
ıam E	19	unstable	straight	?	?	0	
ıam M	19	unstable	sinuous	?	?	13	1.3
ıam W	19	unstable	sinuous	?	?	7	0.7
a 3	26.5	stable	meandering	forest	sand/gravel	4	1
ıd 1	27	unstable	meandering	forest	sand/gravel	3	0.75
·anks	28	trans	straight	ag	sand	0	
·alofa	41	unstable	meandering	?	?	0	
	42	stable	sinuous	?	sand/gravel	0	
a 4	44	stable	meandering	forest	sand -gravel	2	0.5
a 6	99	stable	sinuous	?	?	0	
a 21	?	stable	sinuous	?	?	0	
	?	stable	straight	?	?	0	
hala 11	?	trans	straight	?	?	4	0.88
hala 22	?	trans	straight	?	?	-	
	?	trans	sinuous	?	?	0	
ıd 23	?	?	meandering	?	?	0	

DEBRIS JAM SITES SURVEYED IN MAY 94 : QUALITATIVE CHARACTERISTICS Figure 6

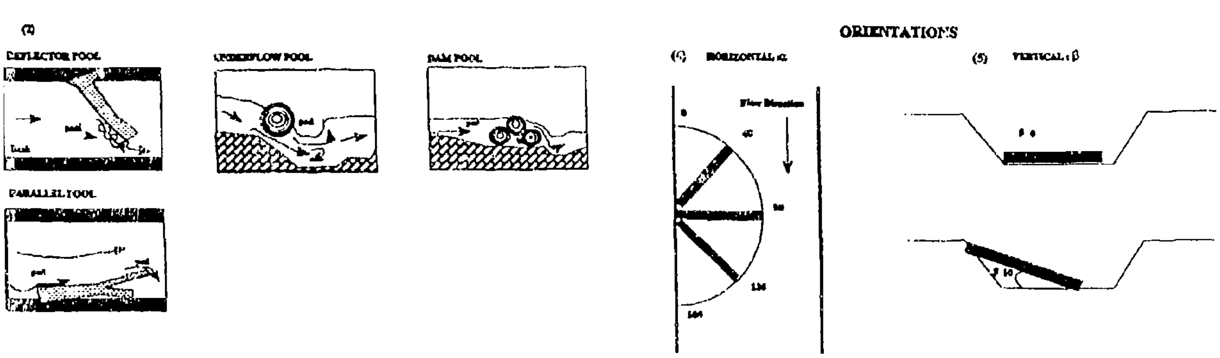
k	Site	Drainage Area	B(beta) (5)	A(alpha) (4)	Flow Direction(2)	Influence(1)
ınd 1	1	27	0	180	Deflector	partial
	2	27	5	90-180	underflow	partial
	3	27	0	150-180	underflow / parallel	partial
ca 3	1	26.5	5	90-110	underflow	partial
	2	26.5	0	90	Dam/deflector/underflow	complete
	3	26.5	0	90	underflow	complete/partial
	4	26.5	0	90-130	dam/underflow	active/complete
ca 4	1	44	0	140	underflow / dam	partial
	2	44	0-45	100-180	deflector / parallel	partial
sham West	1	19	15	90	underflow / dam	partial
	2	19	0	90	underflow	partial
	3	19	0	90	underflow	partial
	4	19	0-15	120-130	underflow / deflector	complete / partial
	5	19	0	90-100	deflector / underflow / dam	partial
	6	19	0	90	dam	active
:ahala 11	1	?	0	90	dam / deflector	complete
	2	?	0	100-110	deflector	partial
	3	?	0	90-100	deflector /dam	complete
	4	?	0	135	deflector	partial
ɜhoe	1	3.7	45-60	90	dam	partial
	2-3	3.7	0-45	100	deflector	complete
	4	3.7	45	90	deflector	complete
	5	3.7	30-40	100-110	deflector	complete
	6	3.7	25-30	90	deflector	complete
	7	3.7	20-30	90-180	deflector	partial
	8	3.7	0-40	90-180	dam	active

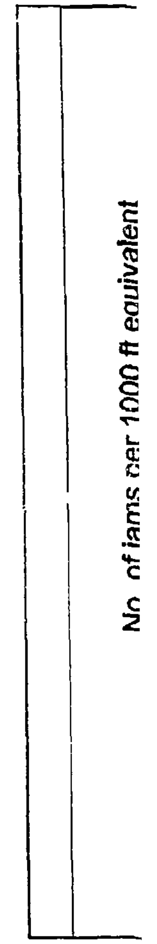
(1)

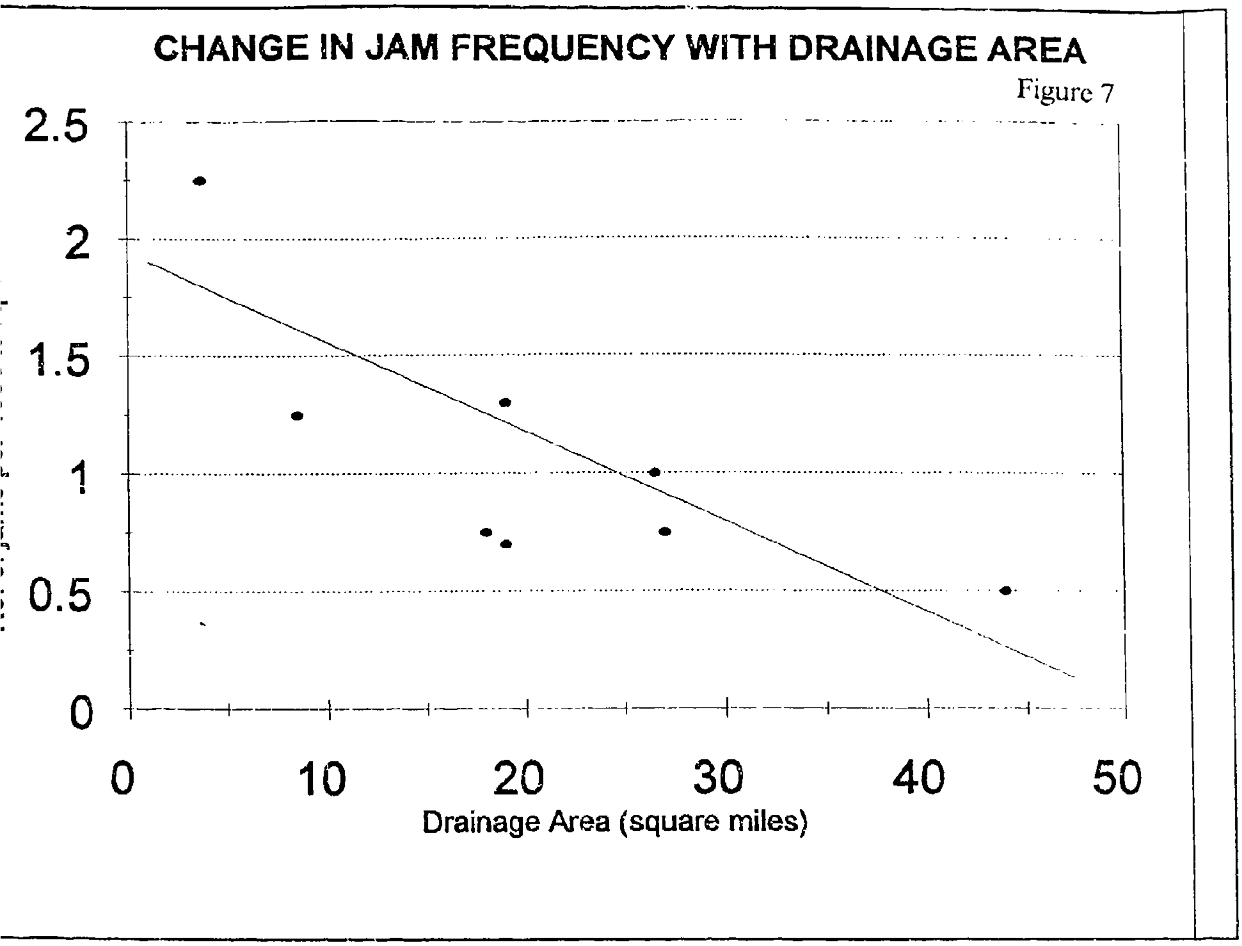
Active: jam forms a complete barrier to water and sediment movement and also creates a distinct step, or fall in the channel profile

Complete : complete barrier to water/sediment movement, but no significant step

Partial : jam is only a partial barrier to flow



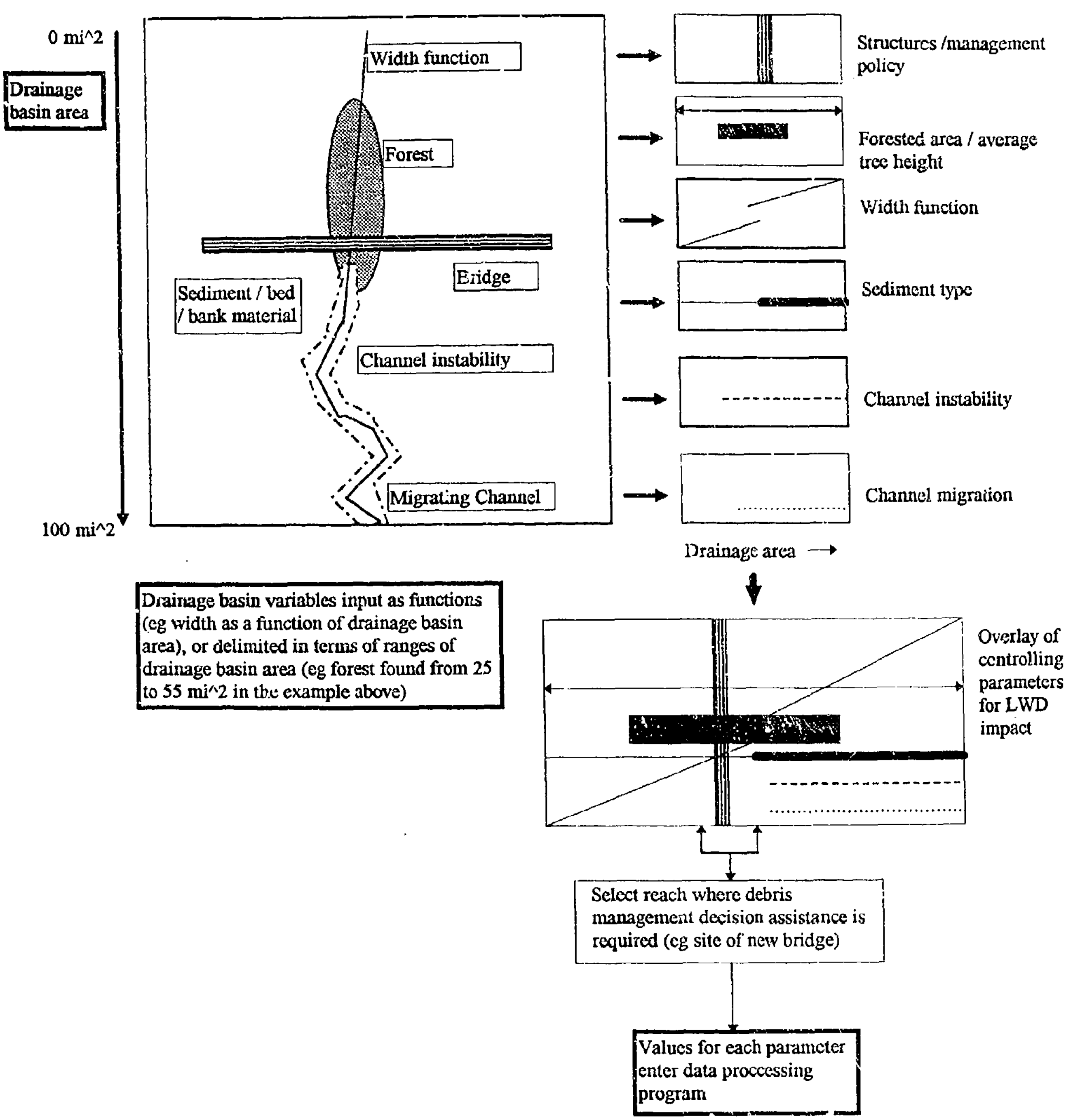




One tailed Pearson Product Moment Significance Test (95% confidence level)

r^2	r	n	critical r at 95% level	Significant?
0.59	0.77	8	0.70	YES

DEBRIS MANAGEMENT SUPPORT SYSTEM : DATA INPUT Figure 8



DEBRIS MANAGEMENT SUPPORT SYSTEM : DATA PROCESSING PROGRAM

Figure 9